

THE POTENTIAL FOR THERMAL ENERGY OF EXHAUSTS FROM TRANSPORTATION AND POWER INSTALLATIONS

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Abstract : *One of the effective remedies for increasing the engines performance and reducing the „greenhouse (heat) effect“ is a conversion of the exhaust gases energy into mechanical one and then using this energy for different purposes, for instance, for air-conditioning and heating of inside of a car. The technical result of this work consists in the increasing of reliable performance heating and air-conditioning system, fuel saving, increasing of overall efficiency and reducing the „greenhouse (heat) effect“.*

KEYWORDS: TRANSPORTATION AND POWER INSTALLATION, AIR-CONDITIONING, EXHAUSTS, EVAPOARATOR.

1. Introduction Modern vehicles are basically equipped with piston internal combustion engines, which are distinguished by low fuel consumption among other energy devices allowing use of other natural fuel resources. We may therefore say that In the near future, replacement of the piston internal combustion engines with any type of analogous device is practically excluded. So, we may say that generally it will remain basic transport facilities in the twenty-first century.

At the same time, there are sharply expanded in the world the vehicle fleets equipped with piston internal combustion engines, which are the consumers of natural fuel resources, the Earth's reserves of which are limited. Consequently, it is obviously that realization of the high-performance cycle in transportation and power installations is of a high importance, since it is associated with global energy problems. On the other hand, realization of cycle which, in terms of topicality, is characterized by minimum ecological dimensions, is of higher importance than high-performance cycle and directly associates with global economic problems. Analysis (resolving) of these problems is reasonable since they are directly interconnected one to another. For instance, an increase of temperature limits causes enhancement of efficiency. In reality, an increase of temperature limits is possible only by increasing the cycle's upper (maximal) temperature limit. At this time, the lower temperature limit is minimally changing. By the same procedure, the cycle's temperature rise is accompanied by an increase in noise, amount of nitrogen oxides and exhaust thermal energy «scattered» into the environment. It all points that the fuel saving and its ecological compatibility are «incompatible» one to another. The fuel saving value measures the efficiency factor. As opposed to fuel saving the engine's ecological compatibility does not depend on the efficiency factor except for amount of carbonic acid in exhaust. This latter one reinforces the atmospheric «greenhouse (heat) effect».

For evaluation of ecological compatibility of the engine there are using such parameters as thermal energy "scattered" into the environment from exhaust gases. Thereby, the major problem in motor industry should be formulated in following way : creation and development of high-performance and high-ecological cycles. In solving these problems it is important to determine admissible ways and possibilities of «incompatibility».

Currently, discussions about limitation of carbon dioxide concentration in air are not incidental (according to ACEA's data the amount of carbon oxide emitted by transport-power installations must be reduced to 20 g on 1 kilometer of traveled.

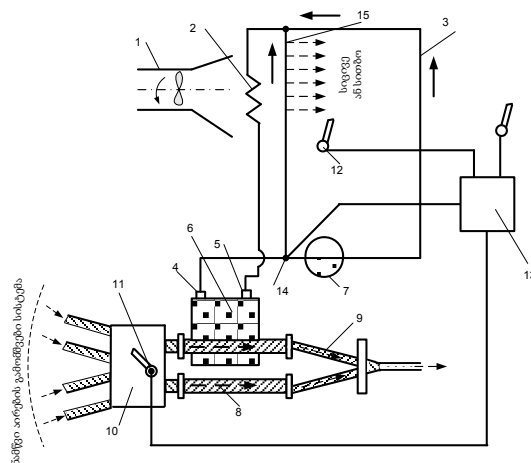
Amount of carbon oxide in exhausts is considerable and despite fact that it is not dangerous substance for human health, it is necessary to reduce its concentration in exhaust gases, As opposed to other chemical substances the carbon dioxide is characterized by high thermal radiation as at the Earth's surface so in the environment that causes the strengthening of global warming effect, i.e. the average temperature rise. Reduction of of carbon dioxide concentration is possible by reducing the fuel consumption or by using of such kind of fuel (for example, the biofuel) the consumption of which won't cause disruption of the balance of carbon dioxide in the environment. However, this is associated

with certain problems. One of the most significant factors for increasing the efficiency thermal energy and reducing the « greenhouse effect » is a conversion of thermal energy of exhaust gases into mechanical operation and using this energy for various purposes, for instance, for air-conditioning and heating of the inside of a car. Schematic diagram for such system is shown on the Pic. 1. The car air-conditioning system comprises the boiler connected to the internal combustion engine manifold and heat exchanger adherent to it, which is placed together with ventilator in inside of a car in the air supply channel. Also, the system is equipped with absorbent devices connected to throttle valve and temperature transmitter [2].

Use of this kind of device for air-conditioning and heating of the inside of a car, in comparison with compressor, has several advantages:

1. temperature of exhaust gases goes down that positively influences on heat balance;
2. internal combustion engine does not spend additional power for driving of the compressor that enables to reduce the fuel consumption;
3. due to absence of mechanical drive the system for driving the additional device from the engine is simplified (no need of driving pulley, bearings, the width of driving belt is reducing);
4. the noise of power installation is reduced;
5. use of other freon substitute agent in heating and air-conditioning aggregate improves environmental conditions and helps to keep the ozone layer

As a drawback of system should be considered an insignificant rework of the engine's exit pipe and irregular shaped boiler.



Pic.1. Schematic diagram for air-conditioning and heating system of the inside of a car

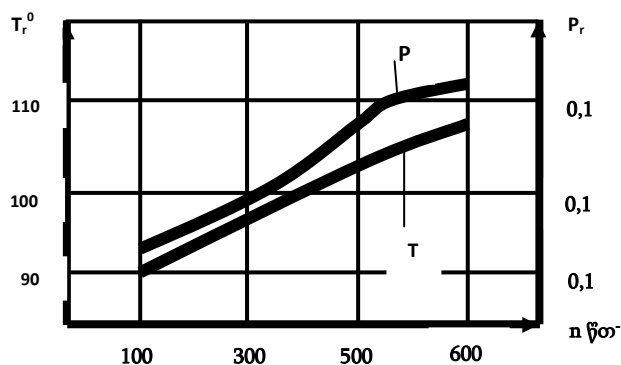
The technical result of this work should be an increase of reliable performance of the vehicle's heating and air-conditioning system, fuel saving, increase of overall performance index and reducing the «greenhouse effect». The technical result should be achieved at the expense of effective heat removal from the engine's exhaust manifold (the exhaust gases temperature is used

directly). Due to design simplicity and with a glance of an increase of reliable performance, at the additional pipe of the internal combustion engine's exhaust manifold lengthening there is mounted the boiler filled with ammonium hydrate solution, which for the purpose of direct use of engine's exhaust gases, is connected to the exhaust pipe by means of inlet and outlet tubes, but the additional channel ensures regulation of temperature in the system. .

The air-conditioning and heating system of the vehicles' inside space comprises the heat exchanger 2, placed in the air supply channel 1, connected to air pipe 3, which is connected to the boiler 6 by means of tubes 4 and 5. But inside the air pipe 3, between tube and heat exchanger there is placed the absorbent 7 and electric tap 14. The system additionally comprises the exhaust gases outlet tube 9 as well, on which there is mounted the boiler 6. For the purpose of transmission of the excess exhaust gases the main exhaust outlet tube 8 is connected to the heat source exhaust manifold 10 by means of additional tube, in which there is inserted the throttle valve 11, but in the heat exchanger 2 – there is inserted the temperature transmitter 12 and the mode switching electric tap 14 is connected to the control means 13.

Air-conditioning and heating system for inside of a car operates as follows: after running of internal combustion engine the exhaust gas from the exhaust manifold 10 is transferred to additional tube 9, from which the heat is transmitted to the boiler 6 and it heats up the coolant placed in the boiler until $438 \div 448^{\circ}\text{K}$ ($165 \div 175^{\circ}\text{C}$) temperature. The formed steam passing through the absorber 7 is moving to heat exchanger 2, in which from the air supply channel there is placed the ventilator. The heat is removed from inlet air and as a result the cooled air is transmitted to inside of a car. Then, from heat exchanger 2 the coolant's steam passing through the pipeline is moving again to the boiler 6, but for operation of heating system for inside of a car it is necessary to run the electric tap 14 and the coolant's steam from the boiler to absorber passing through the electric tap 14 and pipeline 15 the high-temperature steam is transmitted to heat exchanger 2 and as a result, the warm air is transmitted to inside of a car, as a result of which the cycle starts over again as it has been described above. The process is going on uninterruptedly till the boiler 6 is running. The temperature in the boiler is regulated on the basis of signal received from the transmitter 12, by means of control means 13, regulating the throttle valve 11 and as a result of this, in case of need, releasing the exhaust gases from heat source exhaust manifold 10 to main pipe.

Thus and so, effectiveness of air-conditioning and heating system for inside of a car in the first place, depends on the parameters of exhaust gases. As is generally known, the combustion gas temperature at outlet valve under conditions of constant compression degree is increasing in practice, rectilinearly to the engine's speed mode. At the same time, the pressure of exhaust gases at outlet valve considerably depends on values of gas-distribution phases and operating with engine's nominal speed mode, the pressure of the exhaust gases is increasing [1].



Pic. 2. Dependence of exhaust temperature (T) and pressure (P) variation on engine's speed category

It is necessary to note that the advantages of the proposed heating and air-conditioning system of the inside of a car in comparison with existing systems are as follows: fuel economy (2-3 liters at 100 km by motor car); reliability of heating and air-conditioning system, efficiency and ease of maintenance in operational process; the energy expenditure reduction in the engine's exit system that is explained by more intensive taking of heat from exhaust gases that by-turn, eventually fosters the better removal of cylinders from exhaust gases., improves the parameters of process of filling the internal combustion engine and increases the performance index.

We believe that the car air-conditioning system is very important, especially for cars using in the countries of "eternal summer". However, the freon air-conditioning system is very non-ecological system despite fact that in comparison with other cooling systems they are characterized by high performance index, low specific quantity of metal, no need of high capacities for drives of aggregates and low cost. The air-conditioning absorptive and air system is not used in cars yet due to high specific quantity of metal, need of high capacities for drives of components and low performance index. However, these systems are ecological and they do not impact on the environment due to no use of freon. Lately, the mankind is beginning to think of the world we now live in and in order not to lose it people begin to take measures for elimination of freon and other systems damaging the ozone layer. Thus and so, let's hope that there will be invented and reworked the freon substitute cooling systems.

In accordance with above given analysis it is possible to conclude that in order to ensure the high performance of the air-conditioning and heating system for inside of a car it is necessary to carry out theoretical-experimental study of real system that should enable us to determine the boiler's optimal geometric parameters.

4. Literature

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